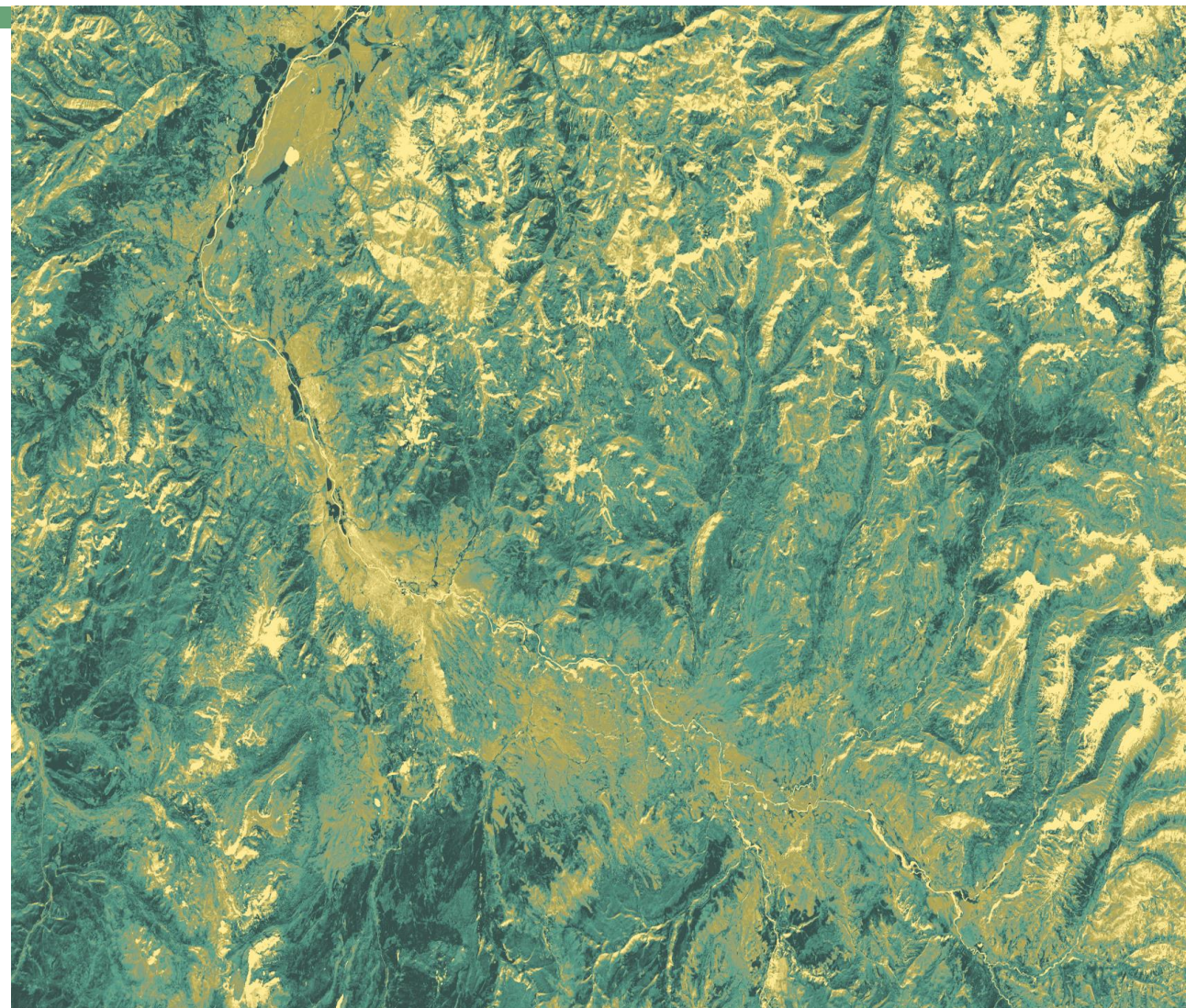




# Assessing Change in Aspen Extent in Northern Yellowstone National Park

Vanessa Bailey, Gabriella Boodhoo,  
Ryan Brinton, Barry McLaughlin,  
Samantha Snowden, Kyle Steen, Aliza White, Sarah  
Payne, Dr. Marguerite Madden,  
Joseph Spruce





# Trophic Cascade | Then

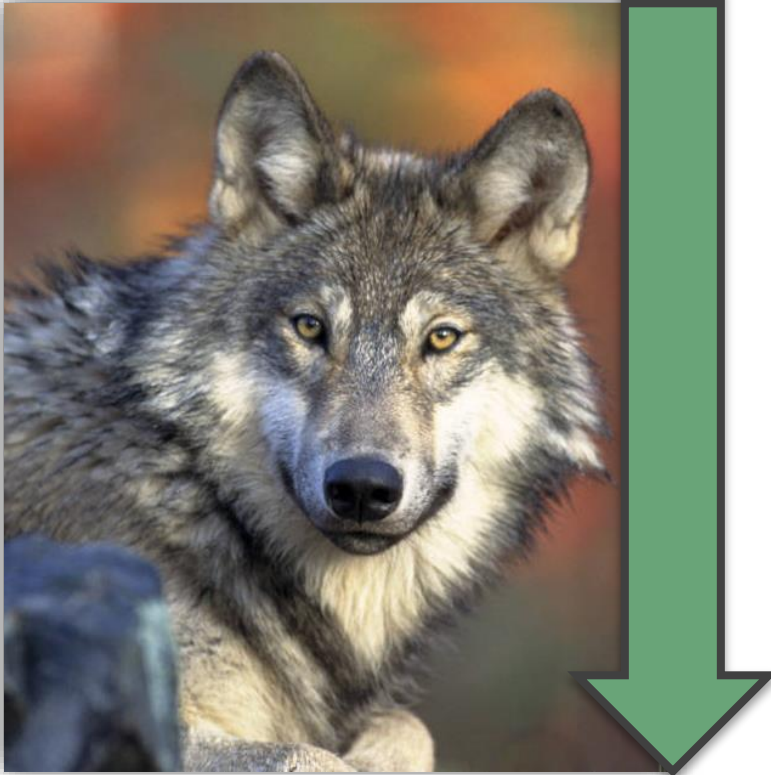


Image Credit: Jacob W. Frank, NPS



# Trophic Cascade | Now

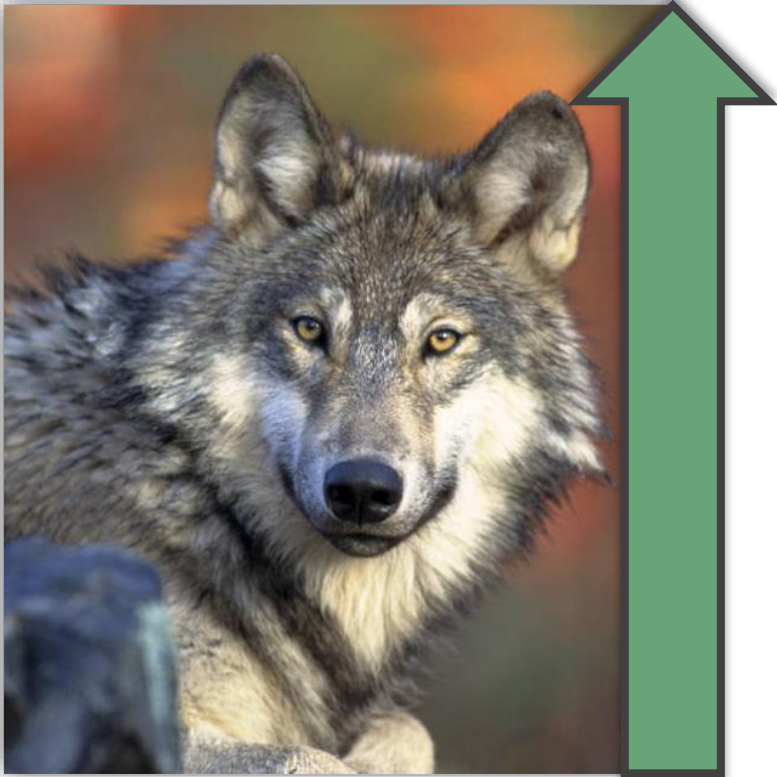


Image Credit: Jacob W. Frank, NPS





# Aspen

- ▶ Keystone species
- ▶ Supports
  - ▶ Biodiversity
  - ▶ Ecosystem health
- ▶ Yellowstone National Park
  - ▶ ~1% of land area
  - ▶ ~95% of aspen stands are over 80 years old



# Objectives



## Explore

different methods to  
classify aspen extent



## Analyze

change in aspen extent  
over time

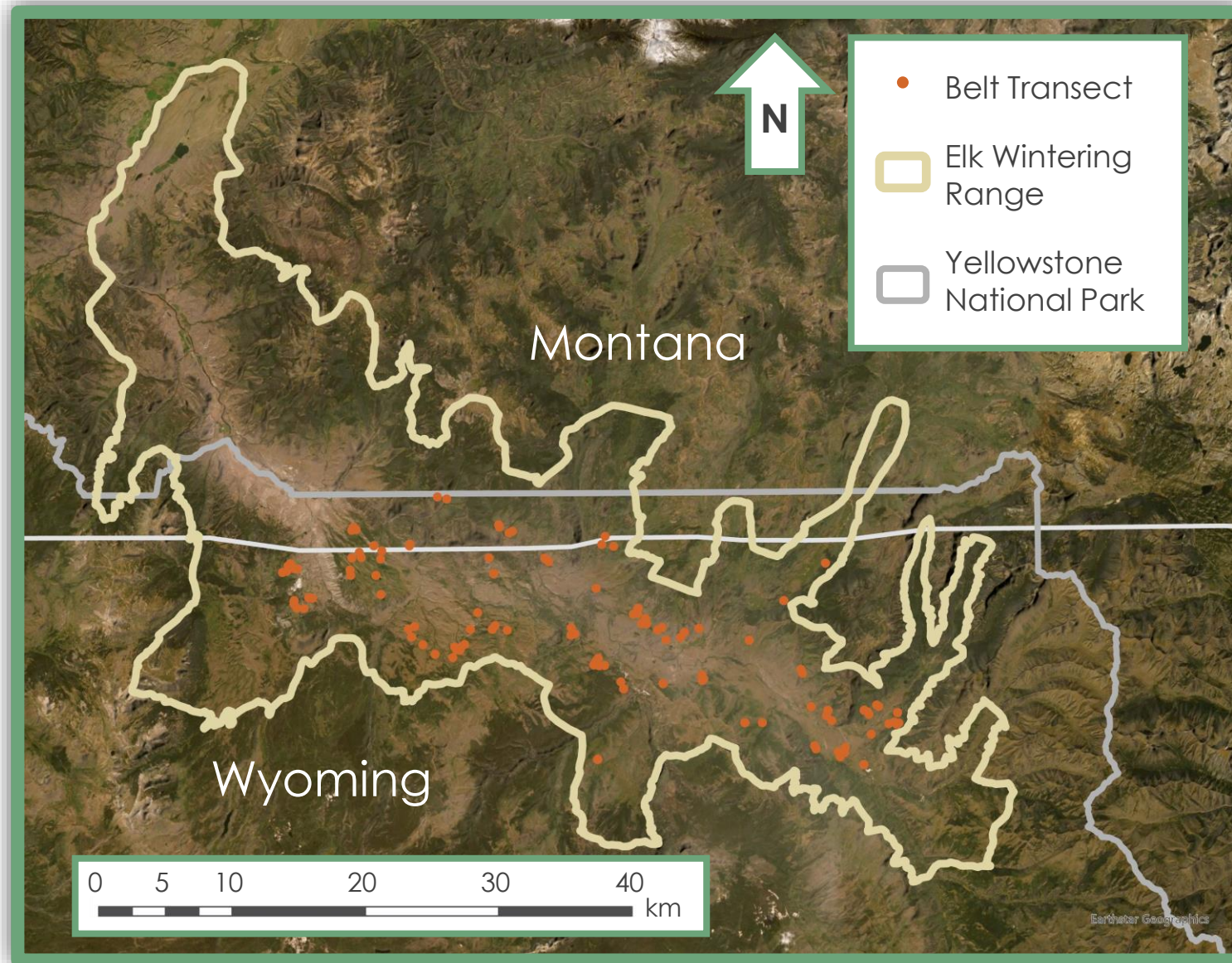


## Depict

change in aspen extent  
visually and quantitatively



# Study Area



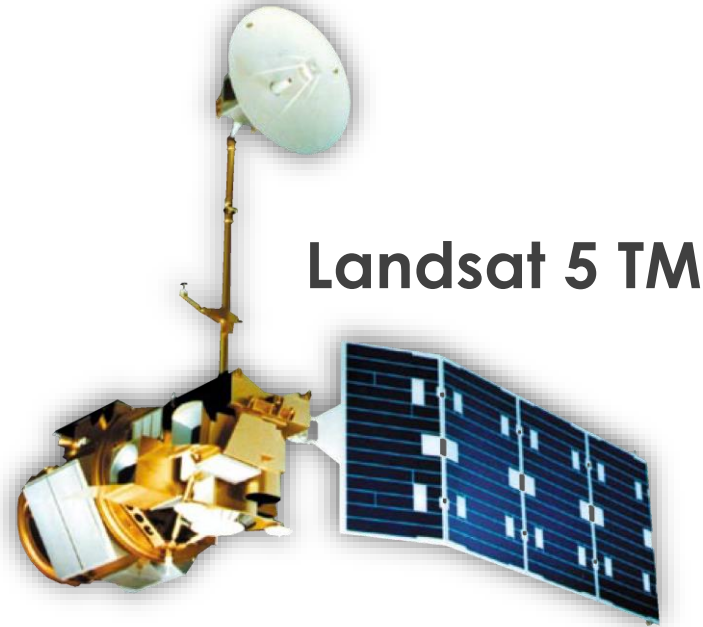
# Data

1986-2021:

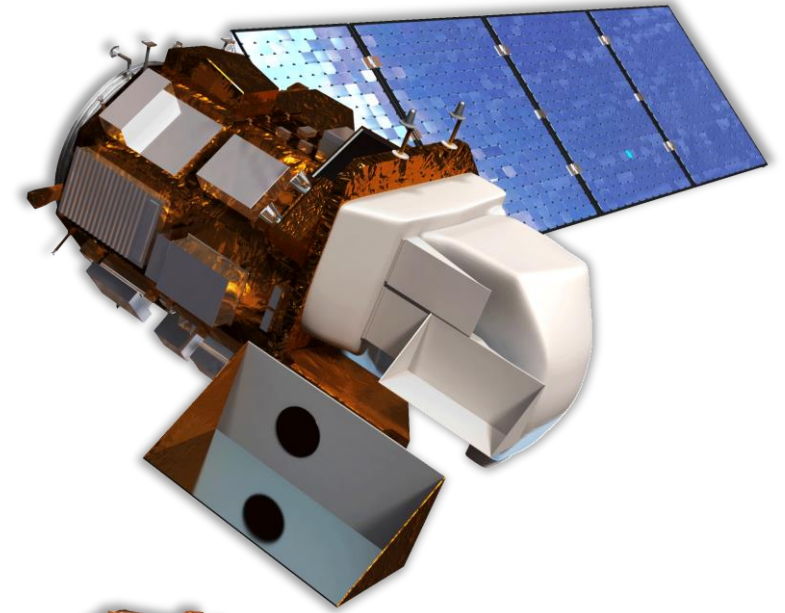
- ▶ Landsat 5 TM
- ▶ Landsat 8 OLI
- ▶ Sentinel-2 MSI

Ancillary:

- ▶ Aspen plot data
- ▶ Land cover point data



**Landsat 5 TM**



**Landsat 8 OLI**



**Sentinel-2 MSI**



# Methods

## Predictors

- ▶ NIR
- ▶ SWIR
- ▶ Red
- ▶ Blue
- ▶ Green
- ▶ Tasseled cap
  - ▶ Greenness
  - ▶ Wetness
  - ▶ Brightness
- ▶ Elevation
- ▶ Slope
- ▶ Aspect
- ▶ NDVI
- ▶ EVI

## Random Forest

Predictors

Training  
Data

Classification

Validation

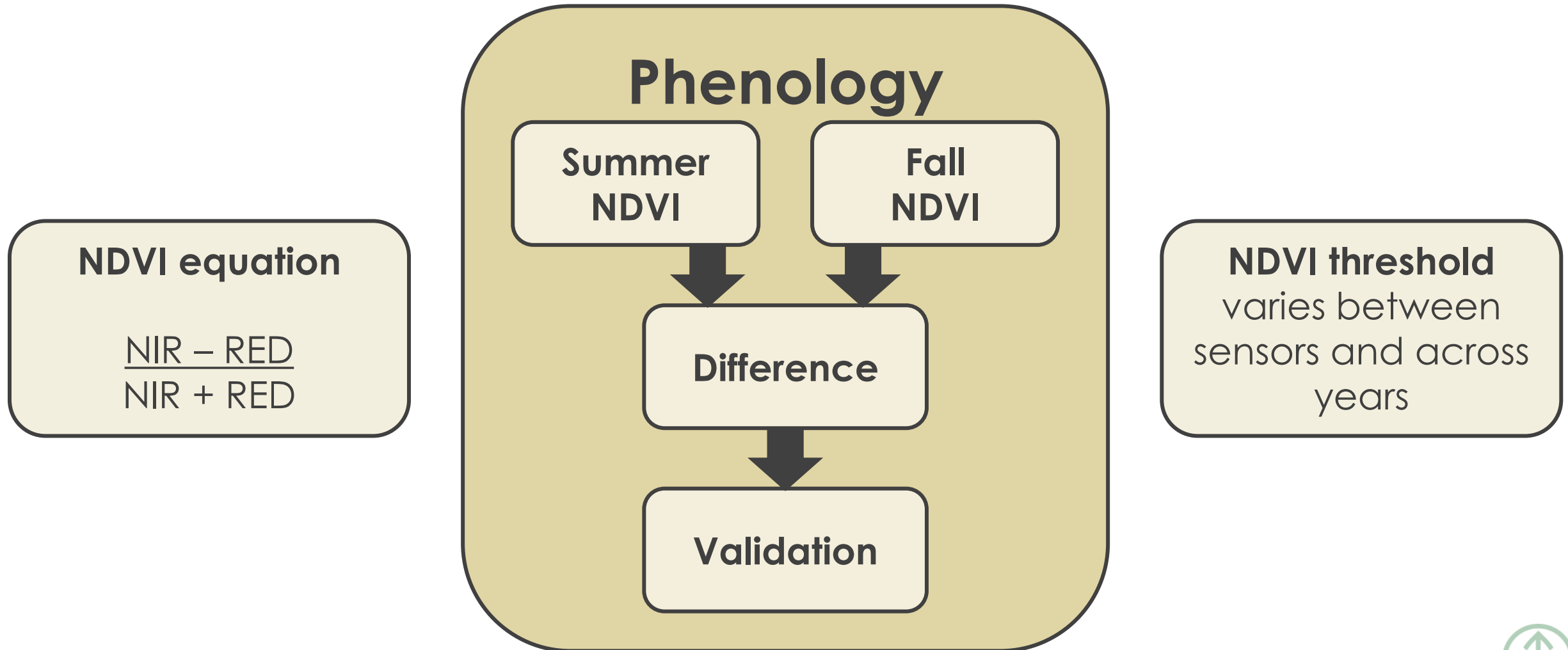
## Classes

- ▶ Water
- ▶ Bare soil
- ▶ Aspen
- ▶ Conifer
- ▶ Other vegetation
  - ▶ Grass
  - ▶ Shrub
  - ▶ Willow
  - ▶ Cottonwood





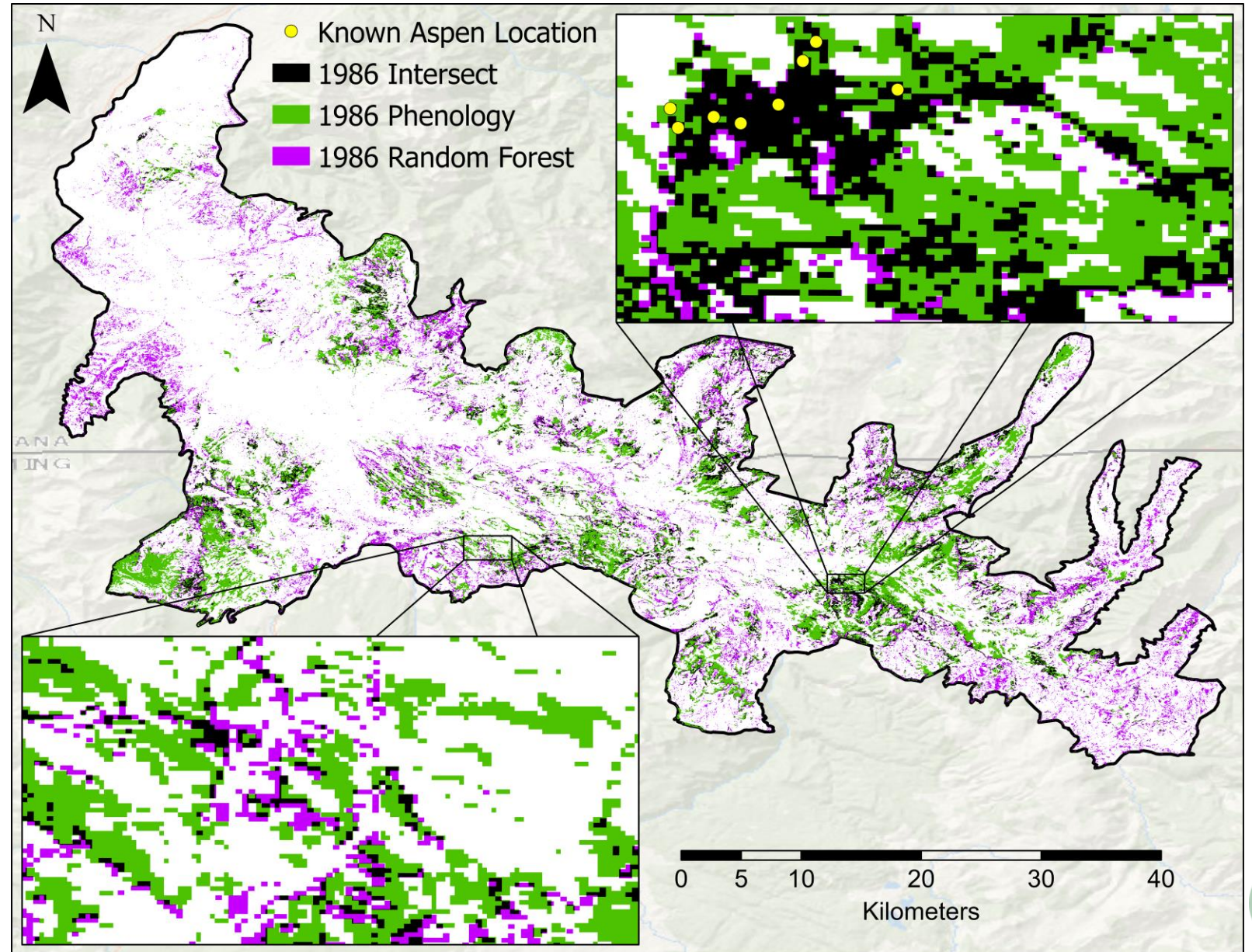
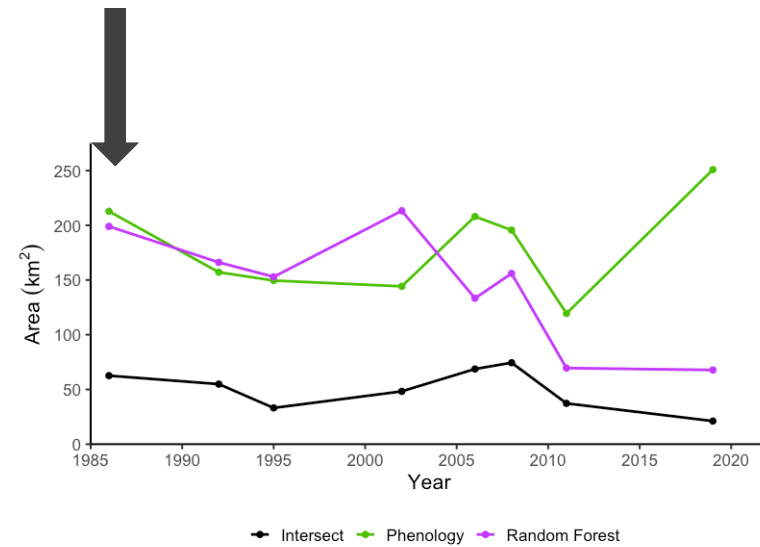
# Methods





# Results | 1986 Comparison

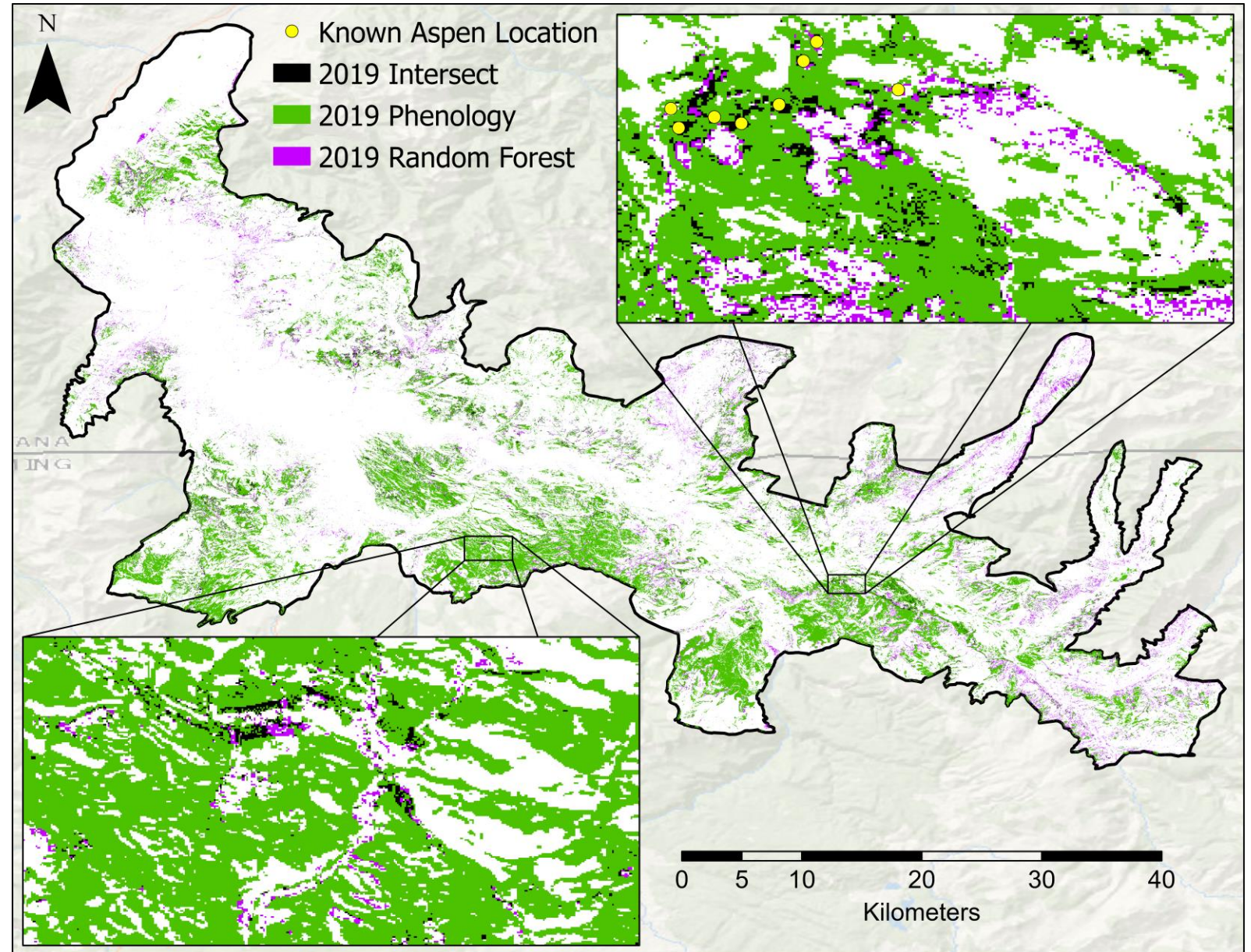
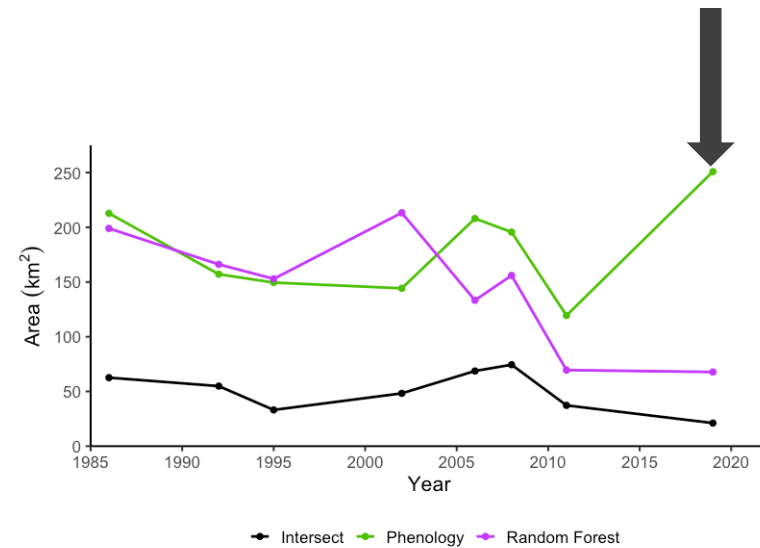
	Area (km <sup>2</sup> )
Intersect	62.62
Random Forest	198.98
Phenology	212.77





# Results | 2019 Comparison

	Area (km <sup>2</sup> )
Intersect	21.12
Random Forest	67.78
Phenology	250.87

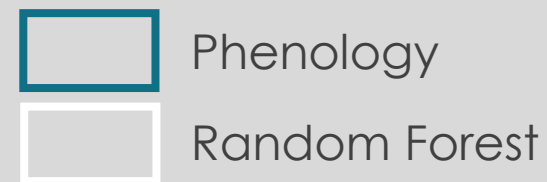
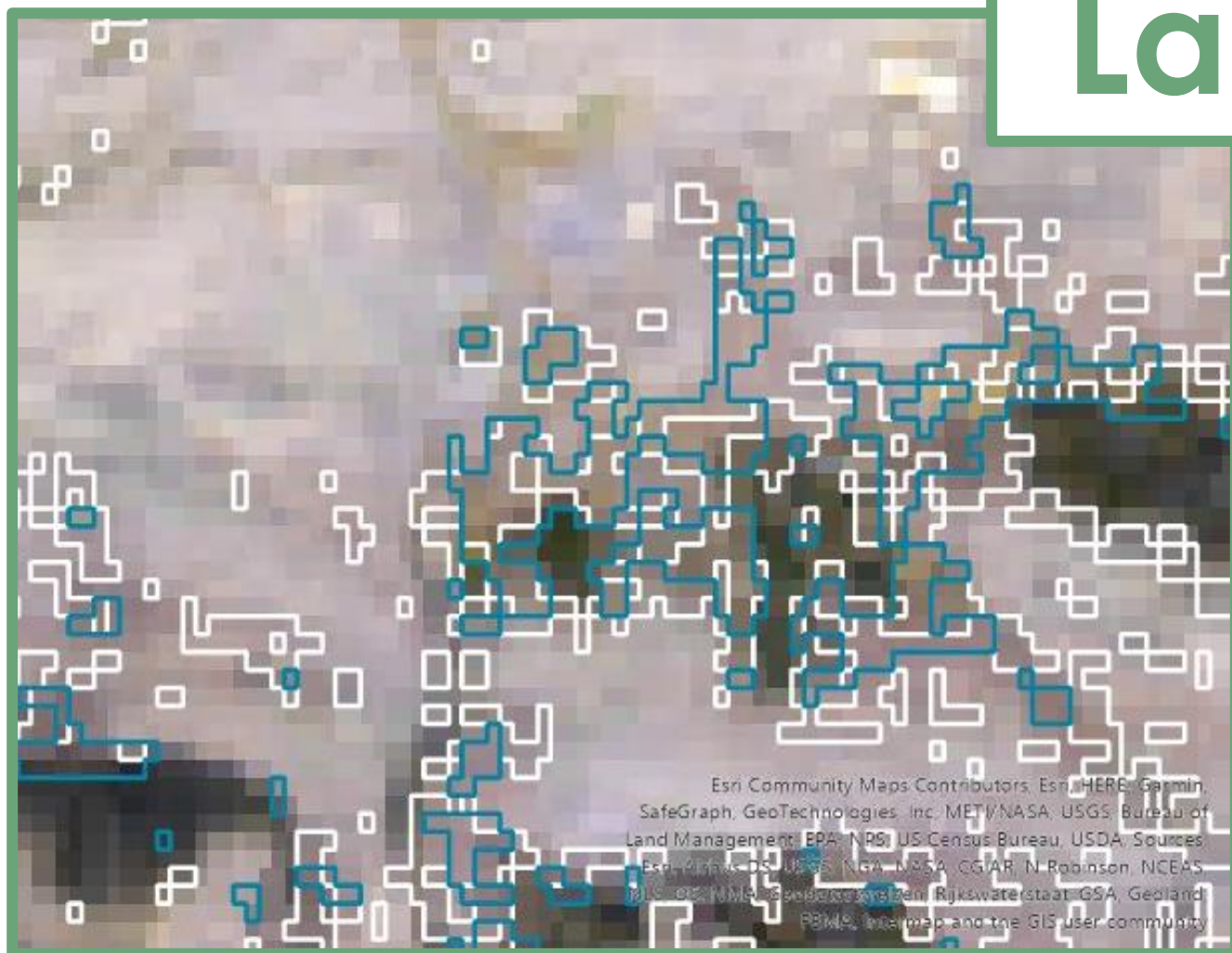




# Results | Example Stand 4 & 5

2  
0  
2  
1

## Landsat 8

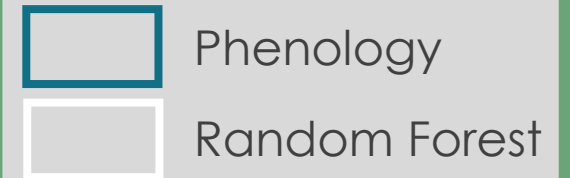
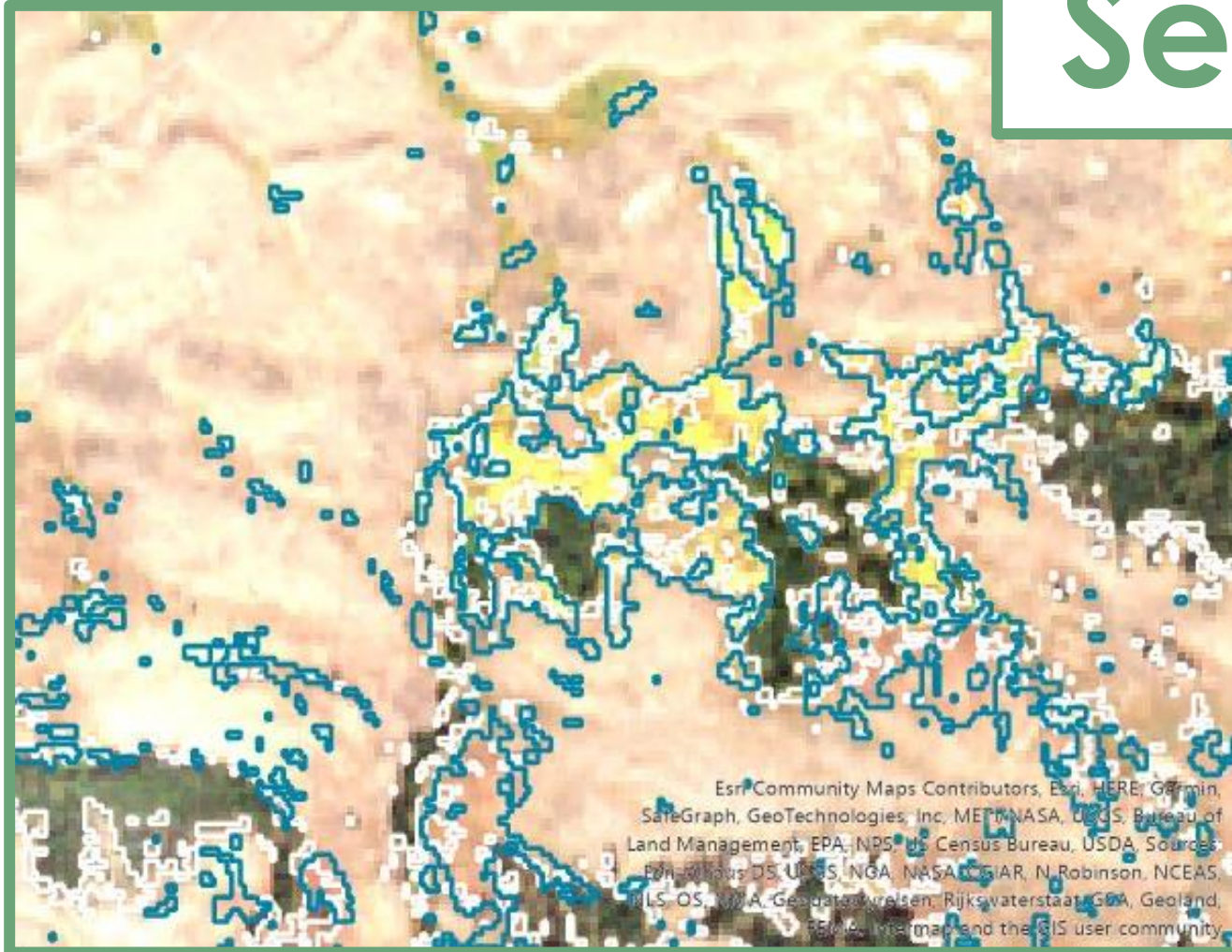




# Results | Example Stand 4 & 5

2  
0  
2  
1

## Sentinel-2





# Limitations



**Spatial**



**Temporal**



**Subjectivity**



**Aspen Site Variability**



# Future Work



**Other factors  
affecting aspen**



**Location of die-off  
or regeneration**



**Specific bands to  
identify aspen**



**Other deciduous  
species trends**



# Conclusion

- ▶ Methods identified different aspen extents
- ▶ Aspen expanded in some areas and contracted in others over time
- ▶ Potential to inform rewilding decisions



# ACKNOWLEDGEMENTS

## Partners

- ▶ **Dr. Daniel Stahler**, Wildlife Biologist
  - ▶ Yellowstone National Park
- ▶ **Dr. Eric Larsen**, Professor
  - ▶ University of Wisconsin – Stevens Point
- ▶ **Dr. Daniel MacNulty**, Professor
  - ▶ Utah State University
- ▶ **Nicholas Bergeron**, Researcher
  - ▶ Utah State University

## Science Advisors

- ▶ **Dr. Marguerite Madden** (Summer & Fall 2022)
  - ▶ University of Georgia, Center for Geospatial Research
- ▶ **Dr. Kunwar Singh** (Summer 2022)
  - ▶ William & Mary, AidData & Global Research Institute
- ▶ **Joseph Spruce** (Fall 2022)
  - ▶ Science Systems and Applications, Inc.

## Special Mention

- ▶ **Sarah Payne, Fellow**
  - ▶ NASA DEVELOP National Program
- ▶ **NASA DEVELOP National Program Participants**

- ▶ **Gabriella Boodhoo** (Summer 2022)
- ▶ **Ryan Brinton** (Fall 2022)
- ▶ **Barry McLaughlin** (Summer 2022)
- ▶ **Samantha Snowden** (Fall 2022)
- ▶ **Kyle Steen** (Summer 2022)
- ▶ **Aliza White** (Fall 2022)

This material contains modified Copernicus Sentinel data (2021), processed by ESA.

*This material is based upon work supported by NASA through contract NNL16AA05C. Any mention of a commercial product, service, or activity in this material does not constitute NASA endorsement. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Aeronautics and Space Administration and partner organizations.*